PRODUCT DEVELOPMENT RESEARCH PROGRAM

Title: Development and Evaluation of Rodent Damage-Management Methods, With Emphasis on Repellants, Barriers and Attractants

Goal: Develop new and improved repellent and barrier strategies for damage caused by voles, pocket gophers, rats, and ground squirrels to agricultural crops and property. Develop rodent detection methods and attractants to enhance effectiveness of existing tools, including rodenticides.

Repellant Reduces Buried Cable Gnawing by Gophers—Documented cases of gnawing damage to buried communication and power cables by pocket gophers have been reported over many years. There is a continuing need for improved methods for preventing this damage, and its importance is increasing as cable repair and replacement costs rise. Field trials conducted in irrigated alfalfa by NWRC researchers in Fort Collins, CO, have shown that communication cable samples inserted directly into the underground burrow systems of northern pocket gophers can be protected from gnawing damage by using a repellent treatment consisting of 2-percent capsaicin in a viscous polybutene carrier.

These ingredients were injected within a shrink tubing material surrounding the cable samples and placed in the burrows of 40 gophers for 3 to 6 weeks. In comparison with untreated samples exposed in the underground burrows, the repellant reduced damage to cable samples by between 77 percent (depending upon the width of cable) and 85 percent (depending upon the depth of cable gnawed).

Researchers also tested a commercially available repellent cable treatment with capsaicin contained within a rubberized plastic coating. This treatment reduced damage as assessed by the width of gnawed cable by 34 percent but did not reduce the depth of cable gnawed. Results from 92 samples suggest that using a viscous polybutene carrier that increases oral contact and irritation as gophers attempt to gnaw on cables can enhance the repellent effect of capsaicin. However, when capsaicin is applied in a dried form in a rubberized coating, the repellent effect is greatly reduced.

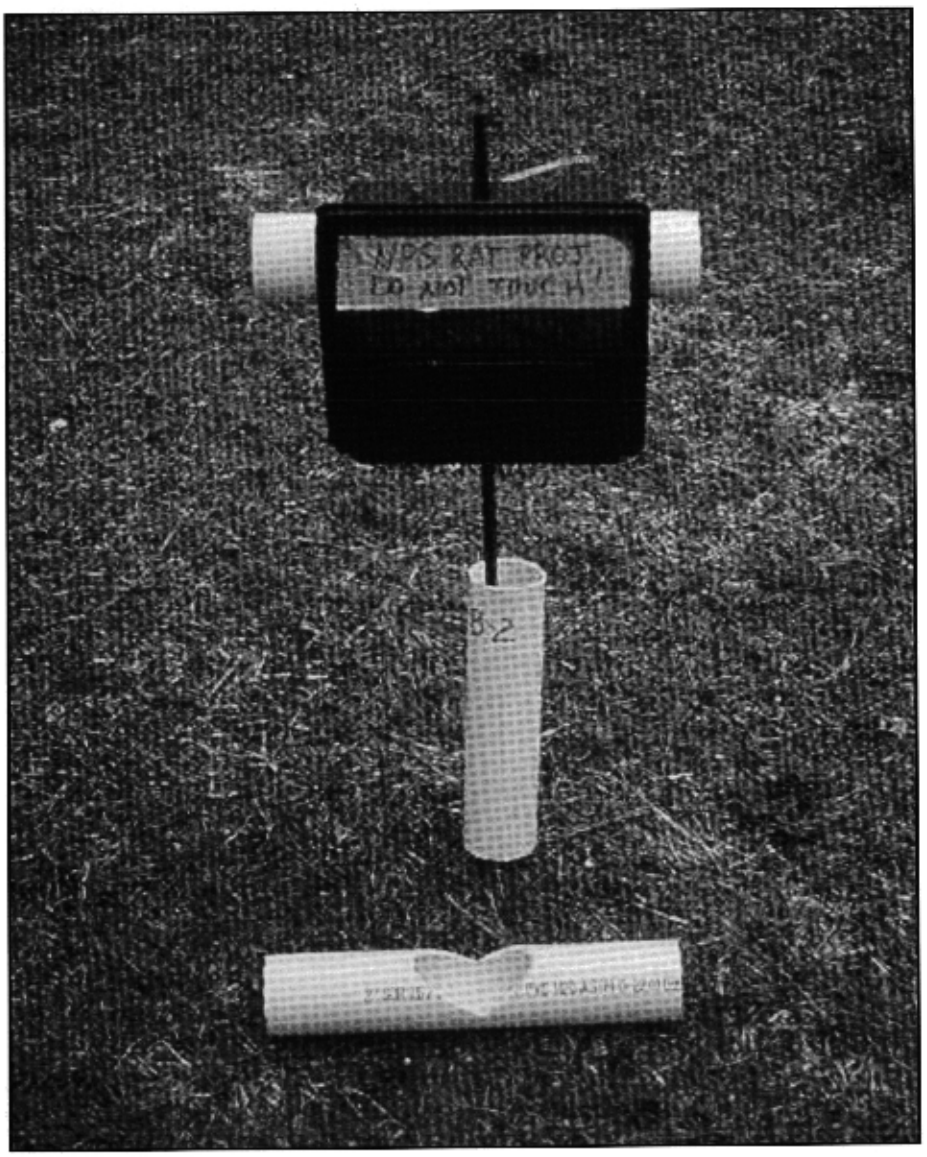
Assessing Wildlife Damage in No-Till Agriculture—Nonirrigated, no- or reduced-tillage agricultural practices, coupled with prescribed crop rotation and fallow schemes, have gained increased attention as a potential way to reduce soil erosion and moisture loss and to increase soil nutrients within the Great Plains agricultural community. Published accounts of small mammal surveys in eastern Colorado have traditionally generated low capture success (~5–10 percent) and low species diversity.

In an effort to document potential wildlife impacts to no-till agriculture, NWRC scientists surveyed small-mammal populations on research crops at a dryland agroecosystem project near Briggsdale, CO. Trap grids were set for 4 consecutive nights in July and again in September 2001. Grids were randomly placed in corn, fallow, millet, pea, soybean, sunflower, and wheat plots. During the first period, only 26 captures (excluding 10 recaptures) occurred in the 798 trap-nights, a 3.3-percent capture success rate. During the second period, only 1 capture (excluding 3 recaptures) occurred in the 834 trap-nights, a 0.1-percent capture success rate. Altogether, only four rodent species were caught: deer mouse, northern grasshopper mouse, thirteen-lined ground squirrel, and western harvest mouse. Most frequent captures and recaptures occurred in wheat and sunflower plots, but these plots were located near wooded areas and farmsteads (good rodent refugia), which probably explains the higher capture success in these crops.

While the low capture success concurs with prior data for eastern Colorado, the drought conditions in 2000 may have been responsible for the extremely low captures, the recaptures, and the lack of species diversity. While it is doubtful that rodents at these low densities posed much of a threat to no-till crops in this study, it became apparent that extensive wildlife damage to corn and soybeans was occurring before harvest. Corn damage was attributed to raccoons and deer; soybean damage was attributed to jack rabbits.

Remote Cameras Used in Ground Squirrel Baiting Operations—When conducting baiting operations to control populations of fossorial rodents, field crews may need to retrieve carcasses for chemical analyses and secondary hazard assessment. The traditional methods of retrieving fossorial rodent carcasses using telemetry and excavation are time consuming and expensive. Researchers need more innovative, efficient, and effective methods to locate and retrieve poisoned rodents from their burrows. NWRC researchers from Fort Collins evaluated the efficacy of the combined use of a burrow probe camera and a retrieval tool (comprised of a 1-m+ length of flexible plastic tubing with a treble hook attached to one end) for locating and retrieving belowground California ground squirrel carcasses after an anticoagulant baiting operation in southern California in May 2001.

Thirty-one dead ground squirrels were located in 654 burrows probed to a maximum depth of 2 m. Twenty-three of the 31 carcasses were retrieved, 18 with the hook rod and 5 by hand. The other carcasses were too deep to retrieve without excessive digging. Researchers also viewed 18 live squirrels underground, half of which appeared to be affected by the anticoagulant. Other underground sightings included three rattlesnakes, a gopher snake, three lizards, and a burrowing owl chick. The mean depth at which dead squirrels were located was 1.0 m, and the mean depth probed for all burrows was 1.4 m. The average time to probe a burrow was 46.1 seconds. The camera system and hook rod are economical and practical tools for locating and retrieving underground rodent carcasses and for collecting behavioral information on live ground squirrels and other burrow occupants.



Introduced Rats Successfully Eradicated From Buck Island—An NWRC scientist from Fort Collins and the WS Alabama State Director revisited the U.S. Virgin Islands (USVI) in both 2000 and 2001. The area they visited is managed by another Federal agency and has suffered severe damage to native flora and fauna from the introduced roof rat. These biologists, along with an NWRC biologist from the Hilo field station, had visited Buck Island in 1998 to design a rat eradication program. The National Park Service (NPS) then contracted the WS Alabama State office to conduct the eradication program between 1999 and 2000.

After a registration for a 0.005-percent diphacinone bait block was obtained from EPA and the USVI, a grid of bait stations was established over the entire 180-acre island. The bait stations were elevated and modified several times to reduce access by crabs and birds while still allowing access by rats. A final operational baiting was conducted in October 2000.

During the December 2000 and April 2001 trips, undertaken to monitor baiting efficacy, no rats were captured over 5 days in any of the traplines scattered about the island. However, many house mice were captured. House mice (another introduced species) had never been reported on the island, and not one had been previously captured in all rat snap-trapping efforts. A population of house mice had probably been on the island for a long period of time but had been greatly suppressed by the rat population.

The baiting operation probably would have also eliminated the mouse population if the bait stations had not been so modified to protect the bait and reduce nontarget animal access. It remains to be seen if this mouse population will cause as many problems as the rats had caused.

Rodent Habitats Studied at a Kansas Airport—In 1999, NWRC researchers from Fort Collins monitored a successful operational control program using a 2-percent zinc phosphide oat bait for field rodents at a Kansas airport. The rodent population was reduced so birds of prey would not be attracted to the airport and cause an airplane strike hazard. In August 2000, Center researchers returned to the airport to check on the recovery of the rodent population and to assess the habitats preferred by the rodents.

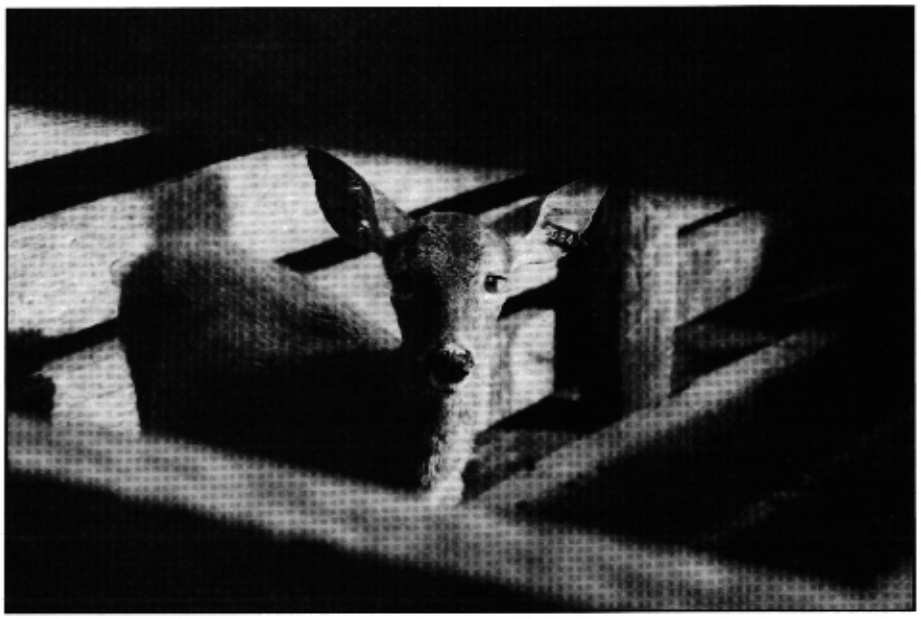
The trap-success rate per 100 trap-nights was lower (9 percent) than before the baiting (20 percent), suggesting that the baiting is still exhibiting an effect 1 year later. However, the 115 captures across diverse habitats suggested that the rodent population was widespread and increasing, and that it would probably soon reach prebaiting densities.

Habitats and land uses appeared to influence rodent densities. The medium-height grass field that had been baited the previous year yielded the most captures. Captures decreased in taller vegetation, tall clover, and riparian areas. The areas supporting the fewest small mammals were the cattle-grazed and short-mowed areas. These findings suggest that habitat management, through mowing or grazing, could reduce the small-mammal populations at airports.

Title: Induced Infertility: A Wildlife Management Tool

Goal: Develop and test economical and effective agents to control fertility in populations of pest mammals and birds.

New Adjuvant Makes a Single-Shot Porcine Zona Pellucida (PZP) Immunocontraceptive Vaccine Possible—Previously, the only adjuvant that has consistently provided high and longlasting immunocontraceptive responses has been Freund's adjuvant. The killed bacteria in Freund's adjuvant recruit immune cells to the site, and the presence of a vaccine–mineral oil emulsion promotes the antigen response by slowing the degradation of the vaccine. NWRC scientists in Fort Collins have developed a new adjuvant using a modification of the currently licensed Johne's disease vaccine which contains *Mycobacterium avium*. NWRC is in the process of obtaining a patent for the new adjuvant, AdjuVac.



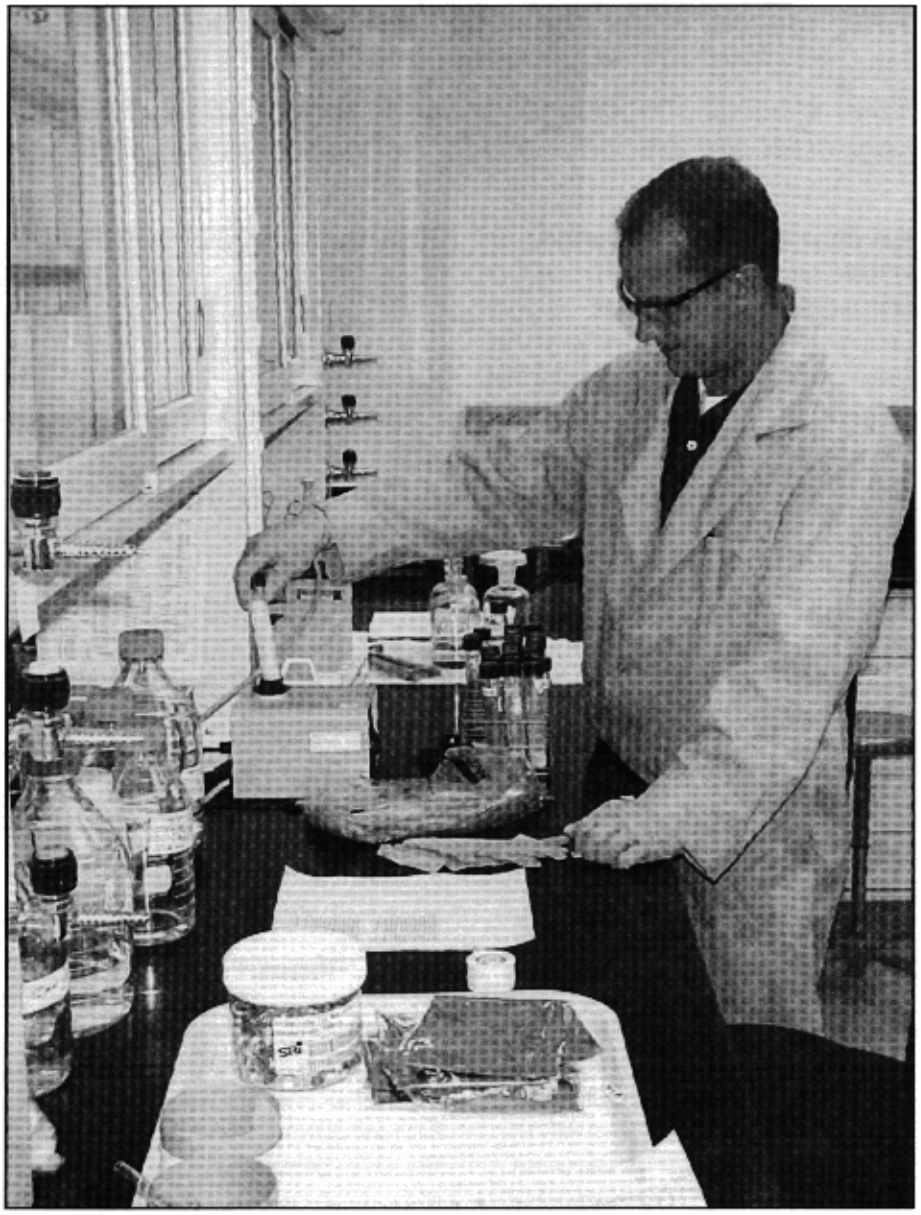
This new adjuvant has allowed NWRC scientists to develop a single-shot PZP vaccine for deer. All previous contraceptive vaccines required at least two injections, called a prime dose and a boost dose. This single-shot technology is being tested at Pennsylvania State University, where only 20 percent of the deer given a single shot had fawns. The single shot looks like it will also protect for the second year. The immunized deer will be monitored for 3 or more years to determine if the contraceptive effects will last.

The single-shot PZP immunocontraceptive vaccine developed by NWRC scientists has also been chosen for use in a white-tailed deer population control-feasibility and efficacy trial in Cleveland, OH, that began in March 2001. This study is being conducted under an experimental research permit issued by the Food and Drug Administration (FDA). The Cleveland study site is suffering from the effects of deer overpopulation. Lethal methods have been most commonly used for control of deer populations in this area, but wildlife managers are seeking alternative, nonlethal ways of reducing deer numbers.

In this study, PZP immunocontraception is being tested as a method of population management. The NWRC vaccine prevents fertilization in immunized does. The effectiveness and convenience of a single injection were the reasons this vaccine was chosen for use in this field trial.

Improved Analytical Chemistry Methods for Risk Assessment of Chemistry-Based Wildlife Damage Management Tools—NWRC chemists in Fort Collins have developed new or improved methods for determining the risk to nontarget animals of chemicals developed to reduce damage caused by a variety of wildlife species. The residue data generated with these methods are critical for assuring that the proposed uses of these tools are accompanied by minimal risk to nontarget animals. For example, in collaborative studies with other Federal agencies and the NWRC Bird Research Program, NWRC chemists analyzed nontarget and target birds that were collected from DRC–1339-baited sunflower and rice fields.

The DRC–1339 residues detected in the collected birds strongly suggest that birds feeding on DRC–1339-baited fields pose little risk to scavenging or predatory wildlife that may potentially consume these birds. Similar analytical approaches are being used to assess the safety of using acetaminophen to control brown tree snakes on Guam, using anthraquinone to reduce bird damage to lettuce and rice, and using diphacinone to control pest rats on Hawaii. These data and the associated risk assessments must be supplied to regulatory agencies to assure that these chemical-based wildlife damage management tools are available for use.



Monitoring Blood Chemistry To Expedite the Development of Wildlife Contraceptives—NWRC chemists have identified marker compounds that can be correlated to contraceptive efficacy in the blood of birds treated with the contraceptives diazacholesterol and nicarbazin. The correlation of blood marker compounds to contraceptive efficacy provides an approach to facilitate development of contraceptives for overabundant waterfowl. By monitoring blood levels of these compounds in wildlife, researchers can evaluate the efficacy of contraceptive formulations in only several weeks. Additionally, such studies can be conducted throughout the year. This approach offers a tremendous increase in research efficiency compared to evaluating the contraceptive efficacy of formulations under field conditions. Such field studies require large numbers of birds, several months, and may only be conducted once a year (during breeding season). Additionally, the quantification of these blood marker compounds may also be used to facilitate the ultimate field testing of a promising contraceptive formulations. In this scenario, blood samples may be obtained and analyzed to determine what percentage of the pest birds are actually consuming the bait and/or how much bait the subjects are consuming.